VEHICLE SECURITY SYSTEM AND METHOD

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present Application for Patent is a divisional and claims priority to Patent Application No. 10/217,393 entitled "Vehicle Security System and Method" filed August 12, 2002, pending, and assigned to the assignee hereof and hereby expressly incorporated by reference herein

BACKGROUND

I. Field of the Invention

[0002] The present invention relates to the field of vehicle security. More specifically, the present invention relates to a method and apparatus for providing vehicle security using a vehicle-based or host-based system to control vehicle access and functionality.

II. Description of the Related Art

[0003] Anti-theft and/or theft-deterrent devices for motor vehicles are known, in the prior art, for preventing or thwarting the theft of motor vehicles. These known devices may be of the active or passive variety and are typically available in many forms (i.e. steering wheel locks, hood locks, ignition system cut-off devices, alarms, etc.). In some cases, these devices may be of a very simple design, while in other cases, they may be of a more sophisticated design. However, as is well known, these known anti-theft and/or theft-deterrent devices and systems may be easily defeated by car thieves, and especially, by professional car thieves. Experience has shown that even the most sophisticated of anti-theft and/or theft-deterrent devices may be defeated by an experienced, and determined, vehicle thief.

[0004] Some prior art theft-deterrent systems prevent movement of a vehicle using an electronic control system. The electronic control system typically will not allow the vehicle to start unless a pre-assigned passcode is entered into the electronic control system by a vehicle operator. The passcode entered by the vehicle operator is compared to a passcode that is stored in a memory as part of the electronic control system. If the two passcodes match, the vehicle is enabled and normal operation of the vehicle ensues. However, if the two passcodes do not match, the vehicle is prevented from starting or the vehicle is prevented from exceeding a certain low-speed threshold.

[0005] One problem with the aforementioned theft-deterrent system is that it is difficult to manage. Often, it is necessary to physically access the electronic control system to change the passcode stored within. This may be due to a number of reasons, but mainly if the password becomes known by one or more unauthorized parties. This may occur intentionally, in the case of a disgruntled driver, or unintentionally, by sloppy safekeeping practices. In other cases, over a long period of time, it may be assumed that the password has been compromised in some fashion.

[0006] Another problem with the electronic control system described above is that the consequence of entering an incorrect password is limited to a single event that is defined, usually, by the manufacturer of the electronic control system. In many cases, it would be desirable to allow a third party, such as a vehicle owner, to define what happens if an incorrect password is entered into the electronic control device.

[0007] What is needed is a theft-deterrent system that is easy to manage while also allowing vehicle owners more control over the consequences of an incorrect passcode access attempt.

SUMMARY

[0008] A method and apparatus for validating a vehicle operator. In one embodiment, an apparatus comprises an input device for allowing entry of vehicle operator identification information, and a memory for storing pre-defined identification information. A processor compares the pre-defined identification information to the vehicle operator identification information and generates a validation message based on the comparison, the validation message indicating whether or not the pre-defined identification information matched the vehicle operator identification information. Finally, a transceiver transmits the validation message to a remote location in response to the comparison.

[0009] Alternatively, an apparatus for validating a vehicle operator comprises an input device for allowing entry of vehicle operator identification information, a transceiver for transmitting and receiving messages, and an interface for allowing a processor to communicate with a vehicle sub-system. A processor connected to the input device, the transceiver, and the interface, is also included, the processor for receiving the vehicle operator identification information from the input device, for generating a message comprising the vehicle operator identification information and providing the message to the transceiver. The transceiver transmits the message to a remote location, wherein the

processor is further for controlling operation of the vehicle by way of the interface until a response to the message is received by the transceiver.

[0010] Alternatively, an apparatus for validating a vehicle operator comprises an input device for allowing entry of vehicle operator identification information, a transceiver for transmitting a message in response to entry of the vehicle operator identification information and for receiving a response to the message, and an interface for allowing a processor to communicate with a vehicle sub-system. The processor is connected to the input device, the transceiver, and the interface, the processor for receiving the vehicle operator identification information from the input device, for generating the message comprising the vehicle operator identification information and providing the message to the transceiver, for receiving the response from the transceiver and for controlling the vehicle sub-system, via the interface, based on the response.

[0011] Alternatively, an apparatus for validating a vehicle operator comprises a transceiver for receiving a validation message from a vehicle and for transmitting a response to the validation message, and a processor for evaluating the validation message and for generating the response to the validation message, the response comprising instructions for controlling operation of the vehicle.

[0012] Alternatively, an apparatus for validating a vehicle operator comprises a signal-bearing medium tangibly embodying a program of machine-readable instructions for performing a method of validating a vehicle operator, executable by a digital processing apparatus, the method comprising operations of receiving vehicle operator identification information from a user interface, storing pre-defined identification information, and comparing the pre-defined identification information to the vehicle operator identification information. A validation message is generated based on the comparison, the validation message indicating whether or not the pre-defined identification information matched the vehicle operator identification information. Finally, transmitting the first message to a remote location in response to the comparison.

[0013] Alternatively, an apparatus for validating a vehicle operator comprises a signal-bearing medium tangibly embodying a program of machine-readable instructions for performing a method of validating a vehicle operator, executable by a digital processing apparatus, the method comprising operations of receiving vehicle operator identification information from a user interface, generating a validation message comprising the vehicle operator identification information, and transmitting the validation message to a

remote location. Subsequently, receiving a response to the validation message, and controlling operation of a vehicle based on instructions contained in the response.

[0014] In another embodiment, a method for validating a vehicle operator comprises receiving a validation message from a vehicle, evaluating the validation message, generating a response to the validation message, the response comprising instructions for controlling operation of the vehicle, and transmitting the response to the vehicle.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] The features, advantages, and objects of the present invention will become more apparent from the detailed description as set forth below, when taken in conjunction with the drawings in which like referenced characters identify correspondingly throughout, and wherein:

[0016] FIG. **1** illustrates a satellite-based wireless communication system in which the method and apparatus for validating vehicle operators is used;

[0017] FIG. **2** is a functional block diagram of one embodiment of a mobile communication terminal used in the communication system of FIG. **1**;

[0018] FIG. **3** illustrates a functional block diagram of an apparatus for validating vehicle operators at a remote location;

[0019] FIG. **4** is a flow diagram illustrating one method for validating a vehicle operator;

[0020] FIG. **5** is a flow diagram illustrating an alternative method for validating vehicle operators; and

[0021] FIG. **6** is a flow diagram illustrating a method for validating vehicle operators that may be used in conjunction with the methods described in FIG. **4** and FIG. **5**.

DETAILED DESCRIPTION

[0022] FIG. **1** illustrates a based-based wireless communication system widely used in the trucking industry for allowing two-way communications between vehicle operators and third parties, such as a fleet management center, family members, governmental authorities, and so on. Although the method and apparatus for validating vehicle operators is described herein with respect to system a satellite-based communication system, it should be understood that any other wireless communication system could be used in the alternative, including cellular and PCS terrestrial communications,

microwave communications, and so on. It should also be understood that the method and apparatus for validating vehicle operators could also be used to validate operators of a number of different types of vehicles, such as buses, aircraft, automobiles, watercraft, or any other machine in which operator validation is desired.

[0023] As used throughout this specification, the term "validation" or "validate" means to determine whether or not a vehicle operator is authorized to operate a vehicle. Also, as used throughout, the term "vehicle operator" means any person who attempts to become validated, whether that person is a vehicle operator, a vehicle passenger, a vehicle maintenance worker, and so on.

[0024] Referring now to FIG. **1**, vehicle **100**, in this example, comprises a tractor-trailer, commonly used in the long-haul trucking industry. Vehicle **100** comprises a mobile communication terminal (MCT, not shown) for communicating with a remote location **102**a via satellite **104**. Generally, the MCT resides onboard a tractor portion of vehicle **100**, in one embodiment. In one embodiment, remote location **102**a comprises a central processing center, otherwise known as a "hub" or "network management center (NMC) and serves as a central communication point between MCT-equipped vehicles and their respective dispatch centers, other designated office(s), shippers, consignees, governmental authorities, family members, and so on. For example, in FIG. **1**, remote location **102**a passes communications between remote host or remote location **102**b and vehicle **100**. Remote location **102**b comprises a vehicle dispatch center which generally monitors and controls a fleet of vehicles **100**.

[0025] Communications between remote location **102**b and vehicle **100** may further be passed to one or more other remote locations, such as remote location (host) **102**c. Remote location **102**c comprises any number of interested third parties to communications between remote location **102**b and vehicle **100**. For example, remote location **102**c could be a another designated office of remote location **102**b, a shipper of goods being carried by vehicle **100**, a consignee of goods being carried by vehicle **100**, a governmental unit, a personal computer, and so on. Communications among remote locations **102**a, **102**b, and **102**c may be carried out by any known communication techniques, including telephone, internet, dedicated lines, wireless links, and so on.

[0026] In addition to remote locations **102**a, **102**b, and **102**c, remote location **102**d is shown which comprises a mobile entity, such as an emergency vehicle (police car, fire truck, etc), an individual, an aircraft, etc. Generally, communications between a remote location **102**a and remote location **102**d are routed through a dispatch center **106**

associated with remote location **102**d. Communications between dispatch center **106** and remote location **102**d may employ any well-known wireless communication method, such as cellular, satellite, RF, Land Mobile Radio (LMR), or others. Communications between dispatch center **106** and remote location **102**a (or other remote locations **102**) generally occur using landline communications, such as a telephone link, a fiber optic connection, the Internet, or others. Located onboard remote location **102**d is a two-way wireless communication device which is able to send and receive information to and from one or more of the remote locations **102** or an MCT. Remote location **102**d might, for example, receive information identifying a certain vehicle **100** that is not operating with a validated vehicle operator operating the vehicle. Remote location may then transmit one or more commands to vehicle **100**/MCT, either directly to vehicle **100**/MCT, or through dispatch center **106**, to disable or impair the operation of vehicle **100**.

[0027] In another embodiment, communications to and/or from vehicle **100** are transmitted directly to/from remote location **102**b and/or **102**c without being processed by a central communication center, such as remote location **102**a.

[0028] The MCT located on vehicle **100** transmits and receives communications wirelessly using, in one embodiment, a satellite **104**. In other embodiments, the MCT uses a terrestrial wireless communication system to communicate with remote location **102**a, such as an analog or a digital cellular telephone system, an RF communication system, or a wireless data communication network, such as a cellular digital packet data (CDPD) network.

[0029] FIG. **2** is a functional block diagram of one embodiment of the MCT, discussed above, herein MCT **200**. MCT **200** generally comprises a processor **202**, a memory **204**, a vehicle operator interface **206**, and a vehicle interface **208**. It should be understood that the functional blocks shown in FIG. **2** may be housed together in a single MCT unit, or they may be distributed in any combination throughout vehicle **100**. For example, the transceiver **210** may or may not be incorporated into the physical structure of MCT **200**.

[0030] Processor **202** generally comprises circuitry necessary for executing machine-readable instructions stored in memory **204**. For example, processor **202** may comprise a microprocessor and supporting circuitry, such as the Intel 80x86 or Pentium series of microprocessors. Of course, other electronic processors could be used in the alternative. Memory **204** may comprise one or more signal-bearing mediums tangibly embodying

one or more programs of machine-readable instructions executable by a digital processing apparatus, such as processor **202**. Typically, memory **204** comprises one or more volatile and/or non-volatile memories, such as a read-only memory (ROM), random-access memory (RAM), electrically erasable programmable read-only memory (EEPROM), a hard drive, a floppy disk drive and floppy disk, or a flash memory. Memory **204** is used to store instructions relating to the operation of MCT **200** including instructions relating to communications with remote location(s) **102**. For example, instructions may be stored relating to the detection of certain vehicle operating characteristics, such as the vehicle location, vehicle speed, engine RPM, load status, driver status, etc. Other information stored within memory **204** generally includes instructions for processor **202** to communicate with remote location(s) **102**. Further, instructions may be stored for managing and controlling vehicle **100**. For instance, if a validation is unsuccessful, instructions may be stored within memory **204** for impairing operation of vehicle **100**. Each vehicle may have a distinct set of instructions stored within memory **204** for controlling vehicle **100** during pre-defined events.

[0031] Vehicle operator interface **206** allows a vehicle operator of MCT **200** to enter instructions into MCT **200**, typically comprising a keyboard or keypad and a visual display device. Of course, vehicle operator interface **206** could alternatively comprise other types of interfaces, such as a microphone for entering audible commands, a pointing device such as a mouse, light pen, trackball, and/or a speaker for generating audible information to a vehicle operator. Other types of well-known devices could be used, either alternatively or in combination, with the devices just mentioned. For example, vehicle operator interface may, alternatively or in addition, comprise a bio-metric device or a card reader.

[0032] Vehicle interface **208** allows processor **202** to communicate with one or more electronic control units (ECUs) located onboard vehicle **100**, either directly, or through one or more intermediary devices, such as an onboard computer (not shown). Vehicle interface **208** comprises a communication port such as a serial data port for communicating, for example, with an onboard computer. Alternatively, vehicle interface **208** comprises a port for interfacing to a vehicle data bus, such as a J1708 data bus commonly used in vehicles today. Examples of ECUs include a fuel regulator/cutoff switch, an ignition controller, an electronic transmission controller, a steering wheel locking mechanism, and a brake activation unit. Other examples of ECUs include electronic devices which provide operational information about vehicle

100 to processor **202**. For example, these types of ECUs comprise a speed sensor, an RPM sensor, an odometer, or a location sensor such as a GPS receiver.

[0033] In modern vehicles, the ECUs may be interconnected by a data bus, such as a data bus as specified in SAE J1708, a commonly known communication standard. The data bus is connected to vehicle interface **208** so that communications may take place between processor **202** and the various ECUs connected to the data bus.

[0034] Transceiver **210** comprises circuitry to modulate information from processor **202** and convert the modulated information into high frequency signals suitable for wireless transmission. Similarly, transceiver **210** also comprises circuitry to convert received high frequency communication signals into signals suitable for demodulation and subsequent processing by processor **202**.

[0035] A vehicle operator of MCT **200**, typically an operator of vehicle **100**, enters vehicle operator identification information into MCT **200** using vehicle operator interface **206**, either prior to operating vehicle **100** or subsequently after initial use. The vehicle operator identification information typically comprises a passcode, such as a predefined vehicle operator name and password, although other types of information may be used to validate the vehicle operator, such as a social security number or, in general, a vehicle operator-defined numeric or alpha-numeric code used in combination (or not) with a password.

[0036] Alternatively, or in conjunction with one or more I/O devices just described, vehicle operator interface **206** comprises a biometric device, such as a fingerprint reader, retinal scanner, or voice recognition device. A vehicle operator of MCT **200** then identifies himself/herself to MCT **200** by providing the necessary biological identification information to vehicle operator interface **206**. In this case, the vehicle operator identification information comprises the biometric information.

[0037] FIG. **3** illustrates a functional block diagram of an apparatus located at remote location **102** comprising a processor **302**, a memory **304**, a vehicle operator interface **306**, a transceiver **310**, and an external interface **308**. Remote location could be a network operations center or hub, a vehicle dispatch center, a law enforcement center, a governmental entity, an individual, a vehicle, or virtually any entity interested in the status of vehicle **100**.

[0038] Processor **302** generally comprises circuitry necessary for executing executable computer instructions stored in memory **304**. For example, processor **302** may comprise a microprocessor and supporting circuitry, such as the Intel 80x86 or Pentium

series of microprocessors. Of course, other electronic processors could be used in the alternative. Memory **304** may comprise one or more volatile and/or non-volatile memories, such as a read-only memory (ROM), random-access memory (RAM), electrically erasable programmable read-only memory (EEPROM), a hard drive, a floppy disk drive and floppy disk, or a flash memory. Memory **304** is used to store information relating to the operation of remote location **102** and, more specifically, information relating to communications to vehicle **100**. For example, one or more databases could be stored within memory **304**, each database relating to a fleet of vehicles and containing information pertinent to each vehicle such as license plate number, vehicle identification number, vehicle type, vehicle maintenance schedules, vehicle location, vehicle operational parameters such as speed, RPM, fuel information, oil pressure, load status, etc. Other information stored within memory **304** generally includes executable computer instructions for processor **302** to communicate with vehicle **100** and one or more remote locations **102**. Further, instructions may be stored for managing and controlling vehicle **100**. For instance, if a validation is unsuccessful, instructions may be stored within memory **304** for impairing operation of vehicle **100**. Each vehicle may have a distinct set of instructions stored within memory **304** for controlling vehicle **100** during pre-defined events.

[0039] Vehicle operator interface **306** allows a vehicle operator to enter instructions into processor **302**, typically comprising a keyboard or keypad and a visual display device. Of course, vehicle operator interface **306** could alternatively comprise other types of interfaces, such as a microphone for entering audible commands, a pointing device such as a mouse, light pen, trackball, and/or a speaker for generating audible information to a vehicle operator. Other types of well-known devices could be used, either alternatively or in combination, with the devices just mentioned.

[0040] External interface **308** allows processor **302** to communicate with one or more remote locations **102**. External interface **308** comprises one or more devices for allowing various forms of two-way communications to occur between the various remote locations. Examples of external interface comprise a telephonic interface, an optical interface, a data interface (for example, a T1, T3, or the like), an internet interconnection device such as a router, a wireless transceiver, or a combination of these devices, as well as others.

[0041] Transceiver **310** comprises circuitry to modulate information from processor **302** and convert the modulated information into high frequency signals suitable for wireless

transmission. Similarly, transceiver **310** also comprises circuitry to convert received high frequency communication signals into signals suitable for demodulation and subsequent processing by processor **302**.

[0042] FIG. **4** is a flow diagram illustrating a method for validating a vehicle operator. The method may be embodied as a set of machine-readable instructions executable by a digital processing apparatus and stored in memory **204**. In step **400**, a vehicle operator of MCT **200** or operator of vehicle **100** identifies himself/herself by entering vehicle operator identification information into MCT **200** using vehicle operator interface **206**. As explained above, the vehicle operator identification information may comprise a vehicle operator name and password, biometric information, or other information. The vehicle operator identification information is provided to processor **202**, where the it is formatted for transmission over the air using transceiver **210**, called a validation message herein, and shown in FIG. **4** as step **402**. The validation message is formatted to include an indication that requests a remote location **102** to perform a validation on the supplied vehicle operator identification information.

[0043] In one embodiment, vehicle **100** is enabled whether a vehicle operator is currently validated or not. If a vehicle operator does not attempt to validate himself/herself to MCT **200** prior to vehicle operation, vehicle **100** may be allowed to operate for a pre-determined amount of time, distance, or some other criteria. Alternatively, a vehicle operator of vehicle **100** may be allowed to start vehicle **100**, but not move vehicle **100** or otherwise operate it without validating himself/herself to MCT **200**. For example, if a vehicle operator of vehicle **100** begins driving without validating himself to MCT **200**, he may be permitted to operate vehicle **100** for a distance of one mile before MCT **200** begins a sequence which at least requests that the vehicle operator validate himself to MCT **200**, i.e., to enter vehicle operator identification information. The request is generally issued through vehicle operator interface **206**. If the vehicle operator fails to validate himself to MCT **200** within a predetermined time period after operating vehicle **100** for one mile, MCT **200** begins a sequence which disables or impairs operation of vehicle **100**, as described later herein. If the vehicle operator of vehicle **100** then validates himself/herself to MCT **200** within a pre-determined time period after the request to validate has been given, vehicle **100** will continue to operate normally.

[0044] In any case, at some time after the validation message is transmitted in step **402**, a response to the validation message is received by MCT **200**, shown as step **404**. The

response contains an indication of whether validation of the vehicle operator was successful or not. Validation is performed at a remote location from vehicle **100**, such as at remote location **102**a, **102**b, **102**c, etc. In step **406**, processor **202** determines whether validation was successful or not. If processor **202** determines that validation was successful, as determined in step **406**, a response is initiated by processor **202**, as shown in step **408**. The response comprises one or more instructions for processor **202** to perform to control operation of vehicle **100**. Typically, processor **202** uses the instructions to control one or more vehicle electronic control units (ECUs) connected through a data bus, which in turn is connected to vehicle interface **208**. In one embodiment, the instructions are stored in memory **204**. In another embodiment, the instructions are provided within the reply message sent by remote location **102**.

[0045] For example, the instructions may allow processor **202** to instruct a fuel control ECU to allow fuel to pass normally from the fuel tank to one or more fuel injectors, carburetors, or the like. Alternatively, or in addition, the instructions include processor **202** sending one or more commands to enable one or more vehicle electronic subsystems, such as a vehicle ignition, a braking system (brakes would be released in this case), an electronic or mechanical clutch or gearshift controller, or a steering wheel control system. Of course, other vehicle systems could be enabled by processor **202**, either alternatively or in addition, to the examples just listed. In an embodiment where the vehicle is able to be operated normally for a predetermined time, distance, or speed prior to validation, processor **202** simply allows the various vehicle sub-systems/ECUs to perform normally, and cancels any actions that would normally be taken if one or more of the predetermined time, distance, or speed is exceeded.

[0046] If validation was unsuccessful, as determined in step **406**, step **410** is performed in which processor **202** determines whether validation has been attempted more than a predetermined number of times, or *n* times, for a particular vehicle operator. For example, n might be chosen as "3" in which case processor **202** determines whether validation has been attempted more than 3 times or not. If validation has been attempted less than 3 times, the vehicle operator is generally prompted to re-enter the vehicle operator identification information, as shown back in step **400**. The validation process at remote location **102** is then repeated.

[0047] If validation has been attempted more than 3 times, as determined by processor **102** in step **410**, processing continues to step **412** in which a response is implemented. A response might include notifying the vehicle operator that the validation attempt

failed and that no further validation attempts will be permitted. Alternatively, or in addition, the response might include processor **202** sending one or more commands through vehicle interface **208** to one or more ECUs or other vehicle control systems to prevent or limit movement, or otherwise impair operation of vehicle **100**. For example, a fuel cut-off switch might be activated, a vehicle braking system activated, or an ignition system might be disabled. Further, processor **202** could take other actions not necessarily related to preventing or impairing vehicle movement. Such other actions might include activating a vehicle horn, headlights, taillights, or interior lights, locking or unlocking one or more doors, and so on.

[0048] Instructions defining the actions taken upon a failed validation attempt may be predetermined and stored in memory **204**, or they may be contained in the response message from remote location **102**. By allowing the failure response to be defined by remote location **102**, greater flexibility is achieved in determining what to do in case of a failed validation attempt. For example, in certain instances, a vehicle owner may wish to change the various combinations of responses to successful or unsuccessful validation attempts from time to time.

[0049] FIG. **5** is a flow diagram illustrating an alternative method for validating vehicle operators. In step **500**, a vehicle operator identifies himself/herself to MCT **200** by entering vehicle operator identification information into MCT **200** using vehicle operator interface **206**. As explained above, the vehicle operator identification information may comprise a vehicle operator name and password, biometric information, or other information. The vehicle operator identification information is provided to processor **202**, where it is compared to pre-defined identification information stored in memory **204**, as shown in step **502**. The pre-defined identification information is generally loaded into memory **204** by authorized personnel of vehicle **100** at a time prior to a validation attempt by a vehicle operator. The pre-defined identification information comprises any information necessary to validate the identity of a vehicle operator attempting to operate vehicle **100**. For example, the pre-defined identification information could comprise a vehicle operator name and password, a social security number or, in general, a pre-defined numeric or alpha-numeric code used in combination (or not) with a password. Pre-defined identification information may alternatively, or in combination, comprise electronic information relating to one or more biometric parameters corresponding to a potential vehicle operator. Such pre-defined

electronic biometric information may comprise information relating to a fingerprint, retina, or voice of a potential vehicle operator, among others.

[0050] If the vehicle operator identification information does not match the pre-defined identification information stored in memory **204**, processing continues to step **504**, where processor **202** determines whether the validation has been attempted more than a predetermined number of times, or *n* times, for any given vehicle operator. For example, n might be chosen as "3" in which case processor **202** determines whether validation has been attempted more than 3 times or not. If validation has been attempted less than 3 times, the vehicle operator is prompted to re-enter the vehicle operator identification information, as shown back in step **500**.

[0051] If validation has been attempted more than *n* times, a message is transmitted by MCT **200** to one or more remote locations **102** that informs remote location(s) **102** that a vehicle operator has attempted to validate more than the pre-determined number of times allowed, possibly indicating an unauthorized attempt to operate vehicle **100**. The message generally comprises the vehicle operator identification information as provided by the vehicle operator during attempted validation. This is shown as step **506** in FIG. **5**.

[0052] As a result of exceeding the maximum allowed validation attempts and subsequent transmission of the message as described in step **506**, a number of potential actions may take place. For example, after the message in step **506** is transmitted, processor **202** may implement a response as shown as step **508**. Such a response may include processor **102** sending one or more commands through vehicle interface **208** to one or more ECUs or other vehicle control systems to prevent or limit movement or operation of vehicle **100**. For example, a fuel cut-off switch might be activated, a vehicle braking system activated, or an ignition system might be disabled.

[0053] Alternatively, processor **102** could wait until a response to the message transmitted in step **506** is received, as shown in step **510**. The response would instruct processor **102** to take specific action(s) as directed by remote location **102**. In this way, a response to an unsuccessful validation can be determined by each owner of vehicle **100**. In step **512**, the action(s) as denoted by the response is implemented by processor **202**. As described earlier, the response may instruct processor **202** to send one or more commands through vehicle interface **208** to one or more ECUs or other vehicle control systems to prevent or limit movement or operation of vehicle **100**. For example, a fuel cut-off switch might be activated, a vehicle braking system activated, or an ignition

system might be disabled. Alternatively, or in addition to the actions described above, processor **102** could take other actions not necessarily tied to preventing vehicle movement. Such other actions might include activating a vehicle horn, headlights, taillights, or interior lights, locking or unlocking one or more doors, and so on.

[0054] Back in step **502**, if the vehicle operator identification information matches the pre-defined identification information stored in memory **204**, processing continues to step **514**, where processor **202** transmits a message to remote location **102** informing remote location **102** of the successful validation. As a result of the successful validation in step **502**, processor **202** may enable various vehicle functions, as show as step **516**. This may include processor **202** sending one or more commands through vehicle interface **208** instructing one or more ECUs or other electronic or electromechanical vehicle systems to allow normal operation of vehicle **100**. Examples of such instructions may include instructions for controlling a fuel control ECU to allow fuel to pass normally from the fuel tank to one or more fuel injectors, carburetors, or the like. Other examples include commands to enable a vehicle ignition, release one or more brakes, enable a clutch, or unlock a steering wheel. Of course, other vehicle systems could be enabled by processor **202**, either alternatively or in addition, to the examples just listed.

[0055] Alternatively, instead of acting unilaterally, processor **202** awaits instructions from remote location **102** after transmitting the message as described in step **514**, indicating a successful validation. In this example, processor **202** waits for a response to the message transmitted in step **514** (shown as step **518**), the response comprising instructions for processor **202** to implement. Generally, these instructions enable one or more ECUs or other vehicle subsystems to allow vehicle **100** to operate normally. In step **520**, processor **202** implements the instructions comprising the response, such as enabling a fuel control ECU, enabling an ignition control ECU, releasing one or more brakes, enabling a clutch, or unlocking a steering wheel. Of course, other variations are possible, as detailed above.

[0056] FIG. **6** is a flow diagram illustrating a method for validating vehicle operators that may be used in conjunction with the methods described in FIG. **4** and FIG. **5**. The method of FIG. **6** describe the steps taken at remote location **102**a when a validation message is received from vehicle **100** with respect to validating a vehicle operator of vehicle **100**.

[0057] In step **600**, a validation message is received from vehicle **100** and evaluates the validation message. The validation message may comprise vehicle operator identification information of a vehicle operator attempting to operate vehicle **100** and a request to validate the vehicle operator associated with the identification information, or it may comprise status information, indicating either a successful validation onboard vehicle **100** or not. If the validation message comprises vehicle operator identification information and a request to perform validation, step **602** is performed. It should be understood that in another embodiment, the request to perform validation is implicit in the validation message itself.

[0058] In step **602**, processor **302** performs a validation using information contained in the validation message. The validation message comprises vehicle operator identification information that was provided by a vehicle operator attempting to operate vehicle **100**. The vehicle operator identification information comprises any information necessary to identify the vehicle operator, including a vehicle operator name and password, any alpha-numeric code, biometric information, or any other information able to identify the vehicle operator. Processor **302** compares the vehicle operator identification information in the validation message to pre-defined identification information stored in memory **304**. In one embodiment, a vehicle operator may attempt validation a pre-determined number of times, in which case steps **600** and **602** are repeated a predetermined number of times if validation is unsuccessful.

[0059] In another embodiment, rather than provide validation at remote location **102**a, processor **302** forwards the vehicle operator identification information to another remote location, such as remote location **102**b, for validation by remote location **102**b. In this embodiment, a status message is returned from remote location **102**b to remote location **102**a, indicating a successful validation or not. Validation is performed generally in the same manner described in the embodiment where validation is performed at remote location **102**a.

[0060] In step **604**, processor **302** determines whether the validation in step **602** was successful, or, in the case of a status message, whether the status message indicated that a vehicle operator of vehicle **100** was successfully validated or not.

[0061] If validation was successful, a number of possible actions are taken by processor **302**. Some of the actions generally may be performed in any order, combined with other described actions in other alternative embodiments, or simply not performed at all. In general, the actions are alterable by an owner of vehicle **100**, a dispatch center, or

other remote location **102** at any time. For example, in response to a successful validation, a dispatch center associated with vehicle **100** might want to change the response from enabling vehicle operation to enabling vehicle operation plus flashing the interior lights of vehicle **100** one time.

[0062] If validation was successful in step **604**, no action is taken by processor **302** in one embodiment, as shown in step **606**. This generally occurs in the case of receipt of a validation messages that simply contains status information.

[0063] In another embodiment, processor **302** consults memory **304** to determine an appropriate response to successful validation, as shown in step **608**. Possible responses include controlling one or more electronic or electro-mechanical devices onboard vehicle **100** so that vehicle **100** may be operated by the vehicle operator that has been successfully validated. Alternatively, or in addition, a response message directed to the validated vehicle operator may be issued. The response message may be pre-defined or it may contain other variable information that may vary over time. The variable information may be stored or deleted by one or more authorized remote stations **102** via external interface **308** and processor **302**. The variable information may comprise a voice or a text message (i.e., email) waiting to be transmitted to a particular vehicle operator or vehicle.

[0064] For example, variable information may include information pertinent to the particular validated vehicle operator, vehicle **100**, a route of travel, or an itinerary associated with vehicle **100** or the validated vehicle operator. A dispatch center **102**b may wish to notify a vehicle operator ABC that his spouse wants him to call home and also to perform a safety inspection on vehicle **100**. A text message is sent from dispatch center **102**b to remote location **102**a to store this variable information into memory **304**. When vehicle operator ABC is validated at a subsequent time, processor **302** consults memory **304** to determine if there is any variable information waiting to be sent to vehicle operator ABC. In this case, processor **302** causes a response message to be transmitted to vehicle **100**, informing him to call home and perform the vehicle inspection.

[0065] In step **610**, a response to the status message/validation message is transmitted to vehicle **100** which includes the response to control vehicle functionality and/or variable information, as described above. In another embodiment, a second response is sent to an entity other than vehicle **100**, for example, any number of remote locations **102**. The second response may include any information pertinent to the successful validation of

the vehicle operator, for instance, an identification of the vehicle operator, the time of attempted validation, the time of successful validation, the location of vehicle **100** when validation or attempted validation has taken place, and so on.

[0066] In another embodiment, after a successful validation, in step **612**, a notification of the successful validation is sent by processor **302** using external interface **308**, to one or more third parties, such as one or more remote locations **102**. The notification may contain information related to the successful validation, such as an identification of the vehicle operator, the time of attempted validation, the time of successful validation, the location of vehicle **100** when validation or attempted validation has taken place, and so on. The notification may, alternatively or in addition, comprise a request to send a response from one or more third parties, pertaining to one or more actions or messages to be transmitted to vehicle **100**. This allows a third party, such as a dispatch center associated with vehicle **100**, to dictate specific actions to vehicle **100** when a successful validation notification is received. Such actions may include enabling one or more vehicle subsystems or ECUs necessary to the operation of vehicle **100**.

[0067] At a subsequent time to sending the notification in step **612**, a response to the notification is received by processor **302** from one or more third parties through interface **308**, as shown in step **614**. The response generally comprises instructions to vehicle **100** which enable one or more vehicle subsystems or ECUs necessary to the operation of vehicle **100**. The response may also comprise voice or text messages or other information directed to the vehicle operator who was successfully validated. If more than one response was received, processor **302** evaluates each received response to decide what information to send to vehicle **100**. For instance, if one response instructs vehicle **100** to be enabled, and another response instructs vehicle **100** to remain or become disabled, processor **302** will decide which action to send to vehicle **100** depending on pre-programmed instructions stored in memory **304**. For example, processor **302** may send the first instructions to be received after the notification step of **612**. Or, one or more messages may be sent to one or more third parties, possibly including the parties that sent a response to the notification, notifying the third parties of the disparity, and requesting resolution from one party. Alternatively, each response received in step **518** may have an associated indication relating to a relative priority of each third party. In this case, processor **302** simply determines which response comprises the highest priority, and transmits a message to vehicle **100** relating to the

information from the third party having the highest priority. Of course, other methods to decide which instructions to send to vehicle **100** could alternatively be used.

[0068] In step **616**, processor **302** transmits a response to vehicle **100** comprising the instructions and information provided by the one or more third parties using transmitter **310**.

[0069] In one embodiment, if validation was not successful as determined in step **604**, no action is taken by processor **302**, as shown in step **618**. This may occur in situations where it is not of particular importance to validate a vehicle operator prior to operating vehicle **100**.

[0070] In another embodiment, processor **302** consults memory **304** to determine an appropriate response to unsuccessful validation, as shown in step **620**. Possible responses include controlling one or more electronic or electro-mechanical devices onboard vehicle **100** so that vehicle **100** becomes or remains in a disabled or impaired state. An impaired state might include only allowing vehicle **100** to travel no greater than a predetermined time, a predetermined speed, a predetermined distance, to select only a subset of available gears, etc. Alternatively, or in addition, a response directed to the vehicle operator who unsuccessfully attempted validation. The response is generally a pre-defined message and may include an explanation pertaining to the failed validation attempt and/or instructions on what to do next. Alternatively, or in addition to the possibilities just mentioned, another possible response is to instruct other vehicle **100** electronic systems to operate. For example, instructions could include sounding a vehicle horn, flashing vehicle lights, including interior or exterior lights, locking or unlocking one or more vehicle doors, and so on. Still another possible response, which may be used in conjunction with the just-described responses includes alerting one or more third parties of the unsuccessful validation. Such third parties might include law enforcement authorities, the owner of vehicle **100**, a dispatch center, or any other remote location **102**.

[0071] In step **622**, a response to the validation message is transmitted to vehicle **100** and/or one or more third parties which may include the response to control vehicle functionality and/or other vehicle systems and information, as described above. The response to vehicle **100** is generally different than the response sent to the one or more third parties, but may include information regarding the instructions sent to vehicle **100** to control its functionality. The response to one or more third parties may include any information pertinent to the unsuccessful validation of the vehicle operator, for instance,

the unsuccessful identification information, the time of attempted validation, the time of unsuccessful validation, the location of vehicle **100** when the unsuccessful validation or attempted validation has taken place, and so on.

[0072] In another embodiment, after an unsuccessful validation in step **604**, a notification of the unsuccessful validation is sent by processor **302** using external interface **308**, to one or more third parties, such as one or more remote locations **102**, as shown in step **624**. The notification may contain information related to the unsuccessful validation, such as the identification information used in the attempted validation, the time of attempted validation, the time of the unsuccessful validation, the location of vehicle **100** when an unsuccessful validation occurred or when the attempted validation has taken place, and so on. The notification may, alternatively or in addition, comprise a request to send a response from one or more third parties, pertaining to one or more actions or messages to be transmitted to vehicle **100**. This allows a third party, such as a dispatch center associated with vehicle **100**, to dictate specific actions to vehicle **100** when an unsuccessful validation notification is received. Such actions may include disabling one or more vehicle subsystems or ECUs necessary to the operation of vehicle **100**, among other actions, discussed earlier with respect to step **620**.

[0073] At a subsequent time to sending the notification in step **624**, one or more responses to the notification is received by processor **302** from one or more third parties through interface **308**, as shown in step **626**. The response(s) generally comprise(s) instructions to vehicle **100** which disable or impair vehicle functionality, control other vehicle systems, such as flashing lights or sounding the vehicle horn. The response(s) may also comprise voice or text messages or other information directed to the vehicle operator who has attempted validation. If more than one response was received, processor **302** evaluates each received response to decide what information to send to vehicle **100**. For instance, if one response instructs vehicle **100** to be enabled, and another response instructs vehicle **100** to remain or become disabled, processor **302** will decide which action to send to vehicle **100** depending on pre-programmed instructions stored in memory **304**. For example, processor **302** may send the first instructions to be received after the notification step of **624**. Or, in the case of disparate instructions, one or more messages may be sent to one or more third parties, possibly including the parties that sent a response to the notification, notifying the third parties of the disparity, and requesting resolution from one party. Alternatively, each response received in step **626** may have an associated indication relating to a relative priority of each third party.

In this case, processor **302** simply determines which response comprises the highest priority, and transmits a message to vehicle **100** relating to the information from the third party having the highest priority. Of course, other methods to decide which instructions to send to vehicle **100** could alternatively be used.

[0074] In step **628**, processor **302** transmits a response to vehicle **100** comprising information as described in step **626**.

[0075] The previous description of the preferred embodiments is provided to enable any person skilled in the art to make and use the present invention. The various modifications to these embodiments will be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other embodiments without the use of the inventive faculty. Thus, the present invention is not intended to be limited to the embodiments discussed herein, but is to be accorded the widest scope consistent with the principles and novel features disclosed herein.

I CLAIM: